

CLAIMS

1. A telecommunications transmission system having at least two VDSL systems, each comprising a pair of modems, said at least two VDSL systems belonging to a binder group common to both VDSL systems, ^{wherein} ~~characterised in that~~

- a transmitter in a first modem in a pair of modem including
 - a extension means (P/S) for cyklic extension of a DMT-symbol by way of adding a prefix or a suffix,
 - a pulse shaper means, adapted to pulseshape sidelobes of a cyclic extended DMT-symbol, and futher
- a receiver in a second modem in a pair of modem including
 - windowing means adapted to multiplying μ samples at the beginning and end of a block of $2N+\mu$ samples; folding and adding $\mu/2$ samples from the beginning of the $2N+\mu$ block of samples to the end of the $2N$ remaining samples; and folding and adding $\mu/2$ samples from the end of the $2N+\mu$ block of samples to the beginning of the $2N$ remaining samples.
 - a stripping means (s/p) for removing said cyclic extension from a DTM-symbol.

2. A telecommunications system, as claimed in claim 1, ^{wherein} ~~characterised in that~~ said modem is a Zippermodem.

3. A telecommunications system as claimed in claim 1, ^{wherein} ~~characterised in that~~ said cyclic extension comprising:

- a suffix which is greater than, or equal to, a channel's propagation delay; and
- a prefix which is greater than, or equal to, a guard time

needed to eliminate inter-symbol interference.

4. A telecommunications system, as claimed in any previous claim, characterised in that said pulse shaped wings are in the form of a raised cosine pulse.

5. A telecommunications system, as claimed in any previous claim, characterised in that the same number of sub-carriers are used for transmission in the up stream direction as are used for transmission in the down stream direction.

6. A telecommunications system, as claimed in any of claims 1 to 4, characterised in that a different number of sub-carriers are used for transmission in the up stream and down stream directions.

7. A telecommunications system, as claimed in any previous claim, characterised in that said transmitter comprises an a b-bit buffer and encoder for receiving an input bit stream at a rate of R bit/s, a n-point IDFT processor for receiving an output from said b-bit buffer and encoder, extension means for adding a cyclic extension to an output of said IDFT processor, a pulse shaper for shaping a DMT symbol output from said extension means, and a digital to analogue converter and low pass filter for converting a DMT symbol received from said pulse shaper to analogue form and passing said DMT to a transmission channel.

8. A telecommunications system, as claimed in any previous claim, characterised in that said receiver includes an analogue to digital converter for digitising a DMT symbol received from a transmission channel, a windowing unit connected to an output of said analogue to digital converter, a stripper unit for removing cyclic extensions to said DMT symbol, an n-

point DFT processor for receiving an output from said stripper unit, a frequency domain equalisation unit for receiving an output from said n-point DFT unit and decoder, and a b-bit buffer for receiving an output from said frequency domain equalisation unit and outputting a bit stream at R bit/s.

9. A modem for use in a transmission system as claimed in any of claims 1-6, characterised in that said modem includes a transmitter as claimed in claim 7.

10. A modem as claimed in claims 9, characterised in that said modem includes a receiver as claimed in claim 8.

11. A method in a telecommunication system having at least two VDSL systems adapted to asynchronously transmit DTM-symbols between each pair of modem having at least two VDSL systems, each comprising a pair of modems, said at least two VDSL systems belonging to a binder group common to both VDSL systems, characterised by the step of

- in a transmitter in a first modem in a pair of modem

- cyclic extend a DTM-symbol by way of adding a prefix and a suffix;
- pulse shaping side lobes of the cyclic extended DMT-symbol;
- transmit the cyclic extended and pulse shaped DMT-symbol to a transmission channel:

- and in a receiver in a second modem in the pair of modem

- windowing the DTM-symbol which transmits on the transmission channel by way of multiplying μ samples at the beginning and end of a block of $2N+\mu$ samples; folding and adding $\mu/2$ samples from the beginning of the $2N+\mu$ block of samples to the end of the $2N$ remaining samples; and folding

and adding $\mu/2$ samples from the end of the $2N+\mu$ block of samples to the beginning of the $2N$ remaining samples, and removing said cyclic extension from a DTM-symbol.

5 12. A method, as claimed in claim 11 characterised by adding a cyclic extension is to DMT symbols, said cyclic extension comprising:

- a suffix which is greater than, or equal to, a channel's propagation delay; and
- a prefix which is greater than, or equal to, a guard time needed to eliminate inter-symbol interference.

10 13. A method as claimed in claim 11 or 12, characterised by forming said pulse shaped wings as a raised cosine pulse.

15 14. A method as claimed in any of claims 11 to 13, characterised by performing said pulse shaping at a transmitter after addition of a cyclic extension to a symbol and prior to digital to analogue conversion.

20 15. A method as claimed in any of claims 11 to 14, characterised by transmitting the same number of sub-carriers in both an upstream and down stream direction.

25 16. A method, as claimed in any of claims 11 to 14, characterised by transmitting a different number of sub-carriers in the up stream and down stream directions.

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